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Description

Method for optimizing the transmission properties and power loss of a high voltage part integrated in a subscriber line circuit for connecting a subscriber line

The invention relates to a method for optimizing the transmission properties and power loss of a high voltage part, integrated in a subscriber line, within a digital telephone exchange in accordance with the precharacterizing clause of patent claim 1.

Accordingly, the invention relates to a high voltage part integrated in a subscriber line circuit for connecting a subscriber line in the form of a two-wire copper line on which not only telephone signals, which are situated within a frequency band provided for speech, for example telephone signals produced by speech, fax or modem applications, but also data signals, e.g. for multimedia services, are transmitted, whose frequency band is situated above the frequency band provided for speech. In this context, such data signals coming from the subscriber line circuit are transmitted at a high rate (e.g. 1.5 Mbit/s, 2 Mbit/s or 6 Mbit/s) within a broadband transmission channel, whereas in the direction toward the subscriber line circuit, such data signals are generally transmitted at a low data rate.

Such an increase in the bandwidth of such subscriber lines in the form of two-wire copper lines is made possible by so-called XDSL technology (Digital Subscriber Line), a new type of transmission method for high-speed data transmission over the customary two-wire copper lines of a telephone network. To prevent analog telephone signals and the XDSL data signals from influencing one another, the latter occupy a frequency band which is situated above the frequency band provided

for speech, with the frequency band available for XDSL data transmission extending, by way of example, up to 552 kHz or 1.1 MHz.

In the context of setting up Internet access for subscriber terminals belonging to subscribers to the conventional telephone network, XDSL technology is currently becoming increasingly important.

For the XDSL method, the switching side of a subscriber line circuit contains devices for isolating and combining telephone signals and data signals and also devices for a modulation method used in this context (e.g. DMT, CAP, QAM).

Such a subscriber line circuit also integrates a high voltage part in which, in the direction toward the subscriber line circuit, not only the aforementioned conventional telephone signals but also the data signals, which are situated in a frequency band above that provided for speech and can be transmitted at a high rate using XDSL technology, are amplified and are supplied to the subscriber line. In the opposite direction, the telephone signals and the data signals, which are situated in a frequency band above that provided for speech and can be transmitted using XDSL technology, are measured for the purposes of subsequent A/D conversion.

During XDSL data transmission within such a high voltage part, the oscillation curve profile of the analog data signals situated within this high frequency band contains intense nonlinear distortions through the zero point which, above all, have an adverse effect on the bandwidth and further processing, e.g. in the form of A/D conversion and decoding of the data signals.

The object of the invention is therefore to devise a method of the type specified in the precharacterizing clause of patent claim 1

such that the data signals, which are situated above the frequency band provided for speech, are transmitted in such a high voltage part with as little distortion as possible and with the highest bandwidth possible, and at the same time the power loss of the high voltage part is optimized.

This object is achieved by the features specified in the characterizing part of claim 1. A further embodiment of the invention is characterized in a dependent claim.

According to the invention, the transmission properties of such a high voltage part are optimized by virtue of the fact that current sources which are integrated in the high voltage part and supply current to the units present in the high voltage part for the purpose of amplifying or measuring telephone and data signals are set, no later than when such data signals are received in the high voltage part, to current values which are such that the data signals within the high voltage part are transmitted with a high bandwidth largely without distortions. In this context, the current values to be set are above the current values for exclusive transmission of telephone signals situated within the frequency band provided for speech.

The method according to the invention is thus used, without any additional hardware complications, to put the high voltage part into a state which is ideal for XDSL data transmission, in which state the occurrence of distortions at the zero point of such data signals' oscillation curve profile is prevented, and also the bandwidth is increased and the power loss of the high voltage part is optimum.

In an advantageous embodiment of the invention, if neither data signals nor telephone signals are being transmitted in the high voltage part, such current sources supply each of the units present in the high voltage part only with current required for their quiescent operation. This puts the high

voltage part into a so-called quiescent state with minimum power loss.

An illustrative embodiment of the invention is explained in more detail below with reference to a drawing.

The figure shows a high voltage part HV integrated in a subscriber line circuit for connecting a subscriber line TL, with a downstream-connected A/D conversion unit C, including its control unit ST.

A subscriber line TL in the form of a two-wire copper line a, b leads into the high voltage part. In the high voltage part, there is a respective connection to a current/voltage sensor S from wire a of the copper line and from wire b of the copper line. From the current/voltage sensor S, the two connections continue to the A/D conversion unit C.

In the opposite direction, two connections run from the A/D conversion unit to respective units having an amplification function, which are situated in the high voltage part. These units having an amplification function are indicated in the figure by means of the amplifiers V with respective resistors W connected in parallel and in series. The path of the aforementioned connections finally ends in the wires a, b at the output of the high voltage part.

The A/D conversion unit has the function of converting the analog telephone and data signals coming from the high voltage part into digital telephone and data signals, and of offloading these telephone and data signals, in each case separately, onto an outgoing line provided for telephone signals and onto an outgoing line provided for data signals.

In the opposite direction, the A/D conversion unit receives digital telephone signals and data signals via respective dedicated lines, and these signals are converted into analog telephone and data

signals and are transmitted in the direction of the amplifiers. Integrated in the A/D conversion unit is a control unit ST from which lines for control signals emerge and, at one end, lead away from the A/D conversion unit and, at the other end, lead to control logic STL integrated in the high voltage part. The control logic is connected to current sources which are integrated in the high voltage part and are indicated by SQ in the figure, and carries out setting for the current sources. Running from the current sources are a respective line to each of the amplifiers V and a line to the current/voltage sensor S, and these lines are used by the current sources to supply current to the amplifiers and to the current/voltage sensor.

During XDSL data transmission, data signals from the wires a, b are received in the current/voltage sensor S, where their current and voltage amplitude values are determined. From there, the data signals enter the A/D conversion unit C, which carries out A/D conversion on the analog data signals and sends the digital data signals obtained from A/D conversion to the outgoing lines for data signals. The control unit integrated in the A/D conversion unit records the received data signals in the A/D conversion unit and reports this to the control logic in the high voltage part. The control logic then sets the current sources to the current values and operating points ideal for XDSL data transmission, which are above the current values for exclusive transmission of telephone signals. The fact that the current/voltage sensor is supplied with a higher current value by the voltage sources changes the transfer function in the current/voltage sensor, which means that virtually no nonlinear distortions can arise in the data signals.

As an alternative to this, before the XDSL data signals are transmitted, a so-called wakeup signal can be sent from outside in the direction of the high voltage part, entering the high voltage part via the

wires a, b. From the high voltage part, the wakeup signal is forwarded to the A/D conversion unit, in which the control unit records the wakeup signal and reports this to the control logic. Accordingly, the control logic sets the current sources to the current values and operating points which are ideal for the XDSL data transmission which is still imminent. This allows the high voltage part to be put into the ideal operating state for XDSL data transmission with optimum power loss even before XDSL data transmission starts.

In the opposite direction, digital telephone and data signals are received in the A/D conversion unit via their lines. In the A/D conversion unit, the D/A conversion is carried out on the telephone and data signals. The analog telephone and data signals obtained are sent in the direction of the high voltage part. In the high voltage part, the telephone and data signals are amplified by the amplifiers and are supplied to the wires a, b.

Before XDSL data transmission is initiated, the control unit in the A/D conversion unit monitors the incoming data signal lines for any incoming digital data signals, or possibly for a wakeup signal. Reception of such data signals or of the wakeup signal is reported to the control logic, which, in turn, sets the current sources to the current values and operating points which are ideal for XDSL data transmission, as a result of which the high voltage part is put into the ideal operating state for XDSL data transmission with optimum power loss. The current sources' current values, which are higher than the current values for exclusive transmission of telephone signals, have an effect on the nonlinearities and the bandwidth of the amplifiers. This allows the amplification-related distortions in the data signals to be prevented, and allows the bandwidth to be increased.

When XDSL data transmission has ended, i.e. when data signals are received in the A/D conversion unit neither from the high voltage part

nor via the lines for data signals, this circumstance is recorded by the control unit and a message is passed on to the control logic. The control logic resets the current values of the current source accordingly. The setting of the current values is dependent on whether or not telephone signals are still being transmitted. For the case in which only telephone signals are being transmitted, the current values are set such that the high voltage part is put into a state suitable for pure telephone signal transmission. If no telephone or data signals at all are being transmitted, current values required for the quiescent state of the units present in the high voltage part are set so that the high voltage part changes over to a quiescent mode with minimum power loss.